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System Application	Asymmetric Digital Subscriber Line	
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Issued By	Jay Hsieh - Design Engineer, R&D_1	
	jay@ycl.com.tw	
Approved By	Roger Wu – Manager, R&D_1	
	roger@ycl.com.tw	
Issued Date		



YCL Electronics Co., Ltd.

No.95, Feng Jen Road. Feng Shan City, Kaohsiung, Taiwan, R.O.C.

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1. Introduction:

The In-Line Microfilter has been specifically designed to implement the functionality of low pass filter in G.lite system. G.lite technology is similar to full rate ADSL in using DMT technology but operates at a lower data rate of up to 1.5 Mbps downstream and 512 kbps upstream, depending on line conditions and lengths.

For POTS voice band service, the low pass filter provide protection from ADSL signal which may impact through non-line or other effects remote devices (handset, fax, voice band modem etc.) and central office operation. For ADSL signal, it also provide protection from the high frequency transients and impedance effect that occur during POTS operation (ringing transients, on-hook, off-hook transients and so on). Because the Microfilter connects directly to the subscriber loop media, it must also provide some protection for externally induced line hits or faults which could damage any attached equipment or endanger humans interacting with the installed equipment. The circuit protection will be provided mostly by standard central office line protection means and additional protection measures built into POTS filter to protect against line overstress which could damage the filter itself.

2. Reference:

- | | | |
|----------|-------------------|---|
| Ref. 1 : | ETS 300 001 | Attachments to the Public Switched Telephone Network (PSTN); General technical requirements for equipment connected to analogue subscriber interface in the PSTN. |
| Ref. 2 : | ANSI T1.413 | Network and Customer Installation Interfaces - Asymmetric Digital Subscriber Line (ADSL) Metallic Interface |
| Ref. 3 : | ITU-T G.992.1 | Asymmetrical Digital Subscriber Line (ADSL) Transceiver |
| Ref. 4 : | T1E1.4/2001-007R3 | In-Line Filter Standard |
| Ref. 5 : | ITU-T K.21 | Resistibility of Telecommunication Equipment Installed in Customer Premises to Overvoltages and Overcurrents |
| Ref. 6 : | ITU-T K.44 | Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents - Basic Recommendation |

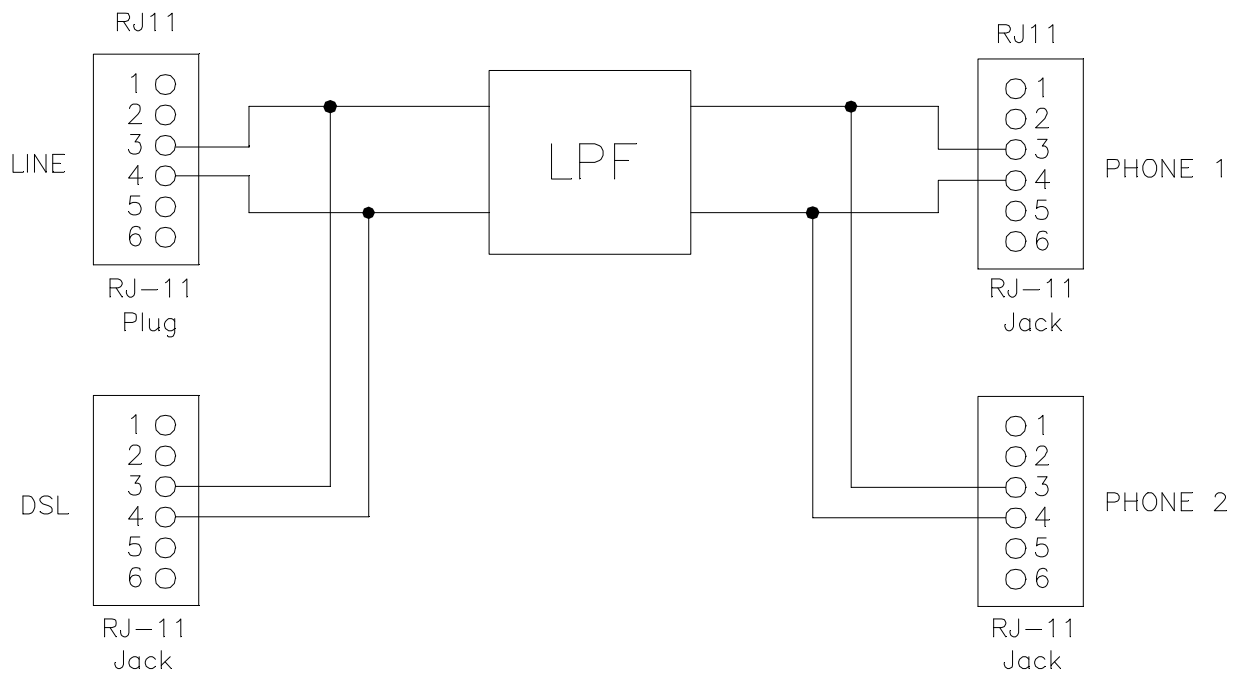
3. Abbreviations:

ADSL	Asymmetric Digital Subscriber Line
CO	Central Office
CPE	Customer Premise Equipment
POTS	Plain Old Telephone Service
RT	Remote Terminal
ADSL-NT	Network termination of ADSL

4. Technical requirements:

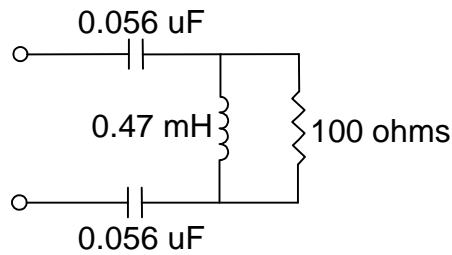
4.1. Schematic:

The following drawing illustrate the schematic of this product.



4.2. ZHP-r Definition:

To facilitate testing of the In-Line Filter independently of the actual modem or specific vendor, ZHP-r is defined to allow proper termination of the Line port during voice band testing. The ZHP-r is valid only for voice band frequency. The combination of capacitors in the ZHP-r is only representative. The input shall be 27nF however derived. ZHP-r equivalent circuit is shown below.



4.3. Electrical Specification:

The low pass filter shall satisfy the following parametric limits shown in this table across the Line side of this device.

Splitter parameters	Electrical requirements	
	Range	Values
Splitter bandwidth		DC to 4 kHz
Nominal voice band		0.3 kHz to 3.4 kHz
Ringing frequency		15.3 Hz to 68 Hz
ADSL band		30 kHz to 1104 kHz
Line Impedance Z_L	300 Hz to 3.4 kHz	600 ohms
Modem impedance	30 kHz to 1104 kHz	100 ohms
Operation voltage voice band		
Nominal signal		21 mVpp to 5.4 Vpp
Ringing signal		40 Vrms to 150 Vrms (113 Vpp to 424 Vpp)
DC voltage		0 V to 105 V
Max. AC voltage		150 Vrms with -105 VDC offset
Max. differential		320 V
Operation current voice band		
Loop current		< 100 mA
DC resistance		
DC resistance	Tip to Tip / Ring to Ring	< 12 ohms
Isolation resistance	Tip to Ring	> 10 Mohms
Differential input blocking impedance		
Line side	20 kHz	> 2 kohms
	30 kHz	> 3 kohms
	5 MHz to 10 MHz	> 2 kohms
	10 MHz to 400 MHz	N / A
Voice band characteristics		
Insertion loss between 600 ohms resistive single filter	1004 Hz	< 0.3 dB
With 5 filters	1004 Hz	< 0.5 dB

Splitter parameters	Electrical requirements	
	Range	Values
Attenuation distortion between 600 ohms resistive single filter (relative to 1004 Hz)	200 to 3.4 kHz	< 0.5 dB
	3.4 kHz to 4 kHz	< 0.75 dB
With 5 filters	200 to 3.4 kHz	< 2.5 dB
	3.4 kHz to 4 kHz	< 4 dB
600 ohms Return loss single filter	SRL-L	> 30 dB
	ERL	> 20 dB
	SRL-H	> 17 dB
With 5 filters	SRL-L	> 20 dB
	ERL	> 13 dB
	SRL-H	> 7 dB
Complex* ZNL-r Return loss single filter	SRL-L	> 25 dB
	ERL	> 15 dB
	SRL-H	> 7 dB
With 5 filters	SRL-L	> 15 dB
	ERL	> 7 dB
	SRL-H	> 1.5 dB
* 1330 ohms in parallel with the series connection of a 348 ohms resistor and a 100 nF capacitor		
Longitudinal conversion loss (LCL)	200 Hz to 1 kHz	> 58 dB
	1 kHz to 3 kHz	> 53 dB
Delay distortion	200Hz to 4 kHz	< 100 μ s
Harmonic distortion	2nd	> 65 dB
	3rd	> 65 dB
Inter-Modulation distortion	2nd	> 60 dB
	3rd	> 65 dB
ADSL band characteristics		
Common mode rejection	40 kHz	> 45 dB
	1.1 MHz	> 45 dB
ADSL band attenuation	30 kHz	> 26 dB
	1 MHz	> 65 dB

4.4. DC characteristics:

All requirements of this specification can be met in the presence of all POTS loop currents from 0 mA to 100 mA. This In-Line Filter can pass POTS tip-to-ring DC voltages of 0 V to 105 V and ringing signals of 40 Vrms to 150 Vrms at any frequencies from 15.3 Hz to 68 Hz superimposed on DC voltages in the range from 0 V to 105 V. The DC resistance from tip-to-ring at the Line port interface with the POTS interface shorted, shall be less than or equal to 25 ohms for one filter.

The DC resistance from tip-to-ground and from ring-to-ground at the POTS interface with the Line interface open shall be greater than or equal to 5 Megohms. The ground point shall be local building or green wire ground. As an objective, the DC resistance should exceed 10M Ω .

4.5. Test methods:

4.5.1. Insertion loss at 1004 Hz:

4.5.1.1. Description :

The test set-up is shown in Figure 1. The insertion loss from the source to the termination shall be measured with and without the filter / ZHP-r combination inserted.

4.5.1.2. Test configuration:

Figure 1. defines the test configuration and the value of the test components that shall be used for transmission measurement in the voice band for the remote POTS filter.

Impedance of signal source = Z_L , Impedance of the load = Z_L

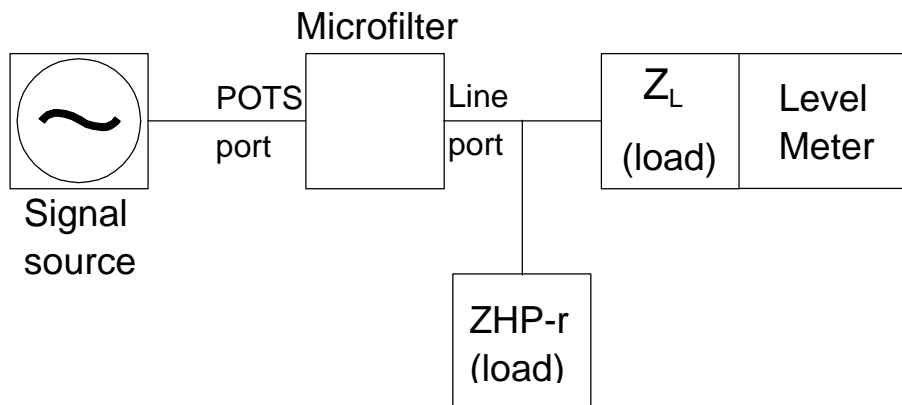


Figure 1.

Note :

1. ZHP-r = the impedance presented to the POTS connection by an ATU-R.
2. Z_L = real impedance 600 Ω .
3. Test apparatus: Function generator HP 33120A or equivalent, Readout oscilloscope HP 54621A or equivalent.

4.5.2. Attenuation distortion in the voice band:

4.5.2.1. Description:

The variation of insertion loss with frequency shall be measured using the configuration in Figure 2. The defined ZHP-r will be attached to the Line port of the filter. The increase in attenuation distortion, relative to the 1004 Hz insertion loss, caused by the POTS filter with the ZHP-r (or modem) load.

4.5.2.2. Test configuration:

Figure 2. defines the test configuration and the value of the test components that shall be used for transmission measurement in the voice band for the remote POTS filter.

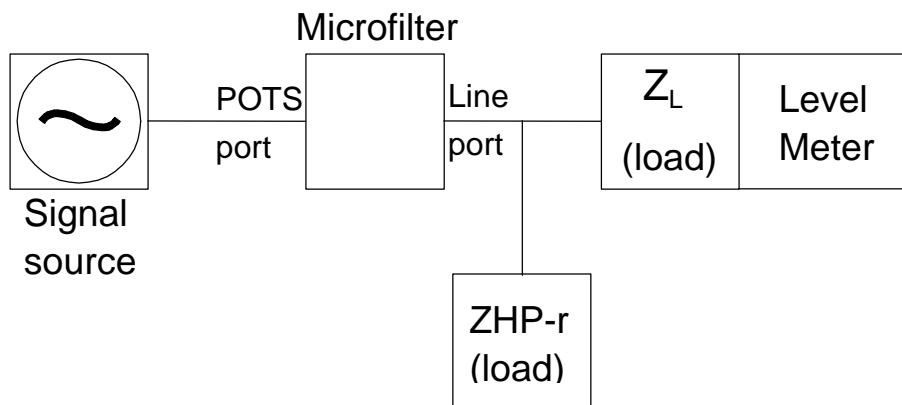


Figure 2.

Note :

1. ZHP-r = the impedance presented to the POTS connection by an ATU-R.
2. Z_L = real impedance 600 Ω .
3. Test apparatus: Function generator HP 33120A or equivalent, Readout oscilloscope HP 54621A or equivalent.

4.5.3. Return Loss:

4.5.3.1. Description:

The return loss of each filter under the specified conditions, either with or without the ZHP-r attached, shall be greater than the value specified in page 6.

4.5.3.2. Test configuration:

Figure 3. defines the test configuration and the value of the test components that shall be used for impedance measurement in the voice band for remote POTS filter. Impedance of the load $Z_1 = Z_L \& Z_{NL-r}$

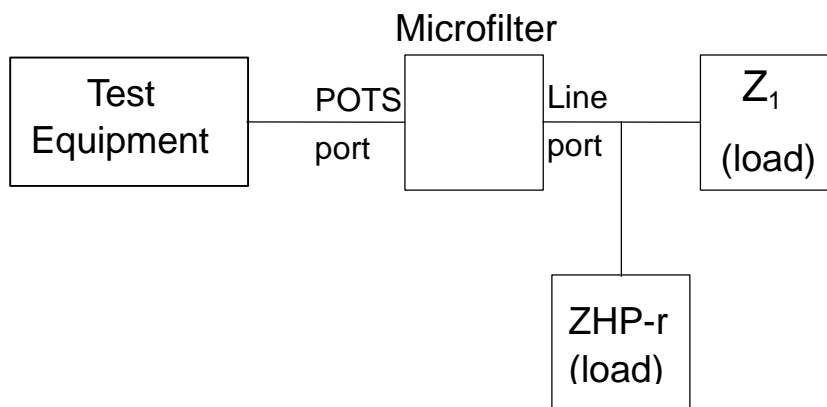


Figure 3.

Note :

1. ZHP-r = the impedance presented to the POTS connection by an ATU-R.
2. Z_L = real impedance 600 Ω .
3. Z_{NL-r} = 1330 Ω in parallel with the series connection of a 348 Ω resistor and a 100nF capacitor.
4. Test apparatus: Impedance Analyzer HP 4284A or equivalent.

5. Environmental conditions:

5.1. Resistibility to overvoltages and overcurrents:

The splitter has to comply with requirements as per ITU-T K.21.

5.2. Climatic conditions:

5.2.1. Operating temperature:

Application indoor
Long time operation guarantee temperature (5 to 40 °C)
Short time operation guarantee temperature (0 to 50 °C)
(According to ETS 300 019, class 3.2)

5.2.2. Storage and transport:

Low ambient temperature - 20 °C
High ambient temperature +85 °C
(According to MIL-STD-202 method 107 / QC-0-20)

5.2.3. Operation humidity:

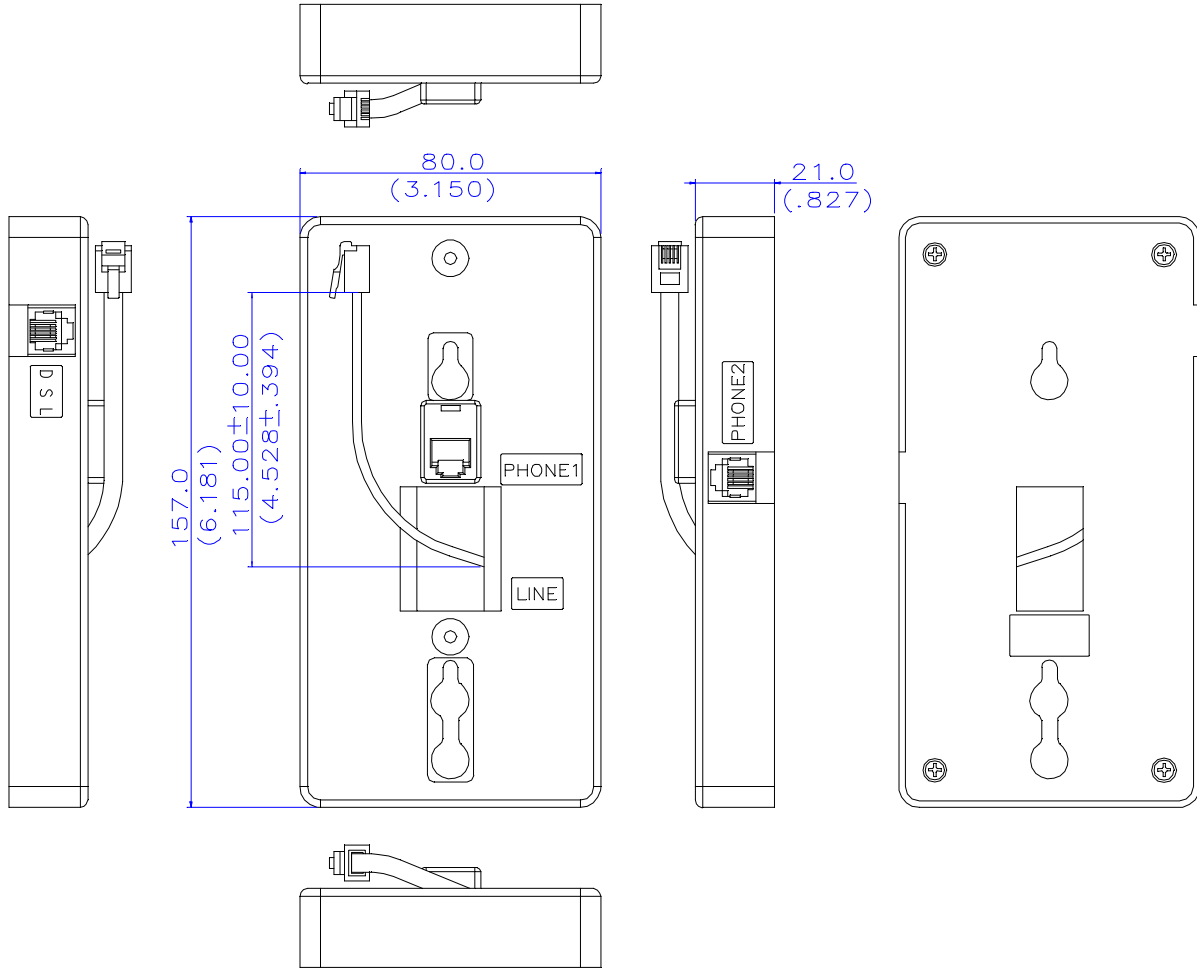
Long time operation guarantee humidity (5 to 85 %)
Short time operation guarantee humidity (5 to 90 %)
Short time : within 72 continuous hours and 15 days in a year

6. Reliability conditions:

Test Item	Description of Testing	Test Condition	Acceptance	Sampling Quantities	
				D.V.T. Pilot Run	Mass Product
1	Visual/Mechanical Examination	By Visual Examination or by using X-Ray, Microscope etc. to Examine sample.	No cracking, Broken, marking color changing and lose marking after washing.	2	4
		Reference:QC-0-12&QC-0-22			
2	Electrical Characteristic	According to clause 4.5 Electrical Specification, pp. 16-17.	No electrical failure.	2	4
		Reference: QC-0-16			
3	Thermal Shock	-20 °C →+85 °C, for 5 cycles.	No electrical failure.	1	2
		Reference: MIL-STD-202 method 107 / QC-0-20			
4	Temperature Humidity Exposure	+50 °C / 95 RH, 96 hrs.	No electrical failure.	1	2
		Reference: MIL-STD-202 method 103 / QC-0-11			
5	Vibration Test	Random vibration / Freq. : 5 ~ 500 Hz / Sweep time : 1 hr. / axis / Force : 2.4 grams	No electrical failure & mechanical faults.	1 box	1 box
		Reference: MIL-STD-202 method 204 / QC-0-21			

7. Mechanical conditions:

7.1. Outline dimension:



Note:

1. Connect the Line side to the wall jack and the phone side the telephone sets.
2. Incorrect connection will significantly affect the performance and operation.
3. Unless otherwise specified, all tolerances are mm (inch) ± 0.25 (0.010).
4. Unit: mm

7.2. Pin assignment:

Position	Type	Tip	Ring
Line	RJ 11 Plug	Pin 3	Pin 4
Phone 1	RJ 11 Jack	Pin 3	Pin 4
Phone 2	RJ 11 Jack	Pin 3	Pin 4
DSL	RJ 11 Jack	Pin 3	Pin 4